July 9, 1935. R. HARDING, JR 2,007,928

UNIFORM DISCHARGE LAMP

Filed Nov. 17, 1930

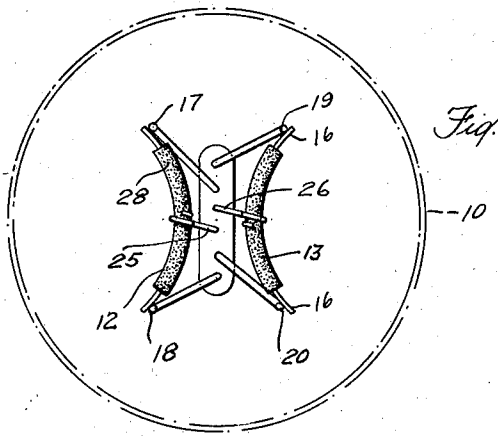


Fig. 1

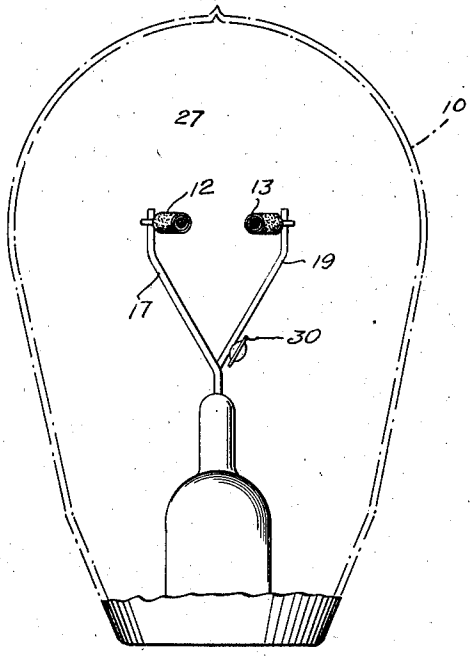
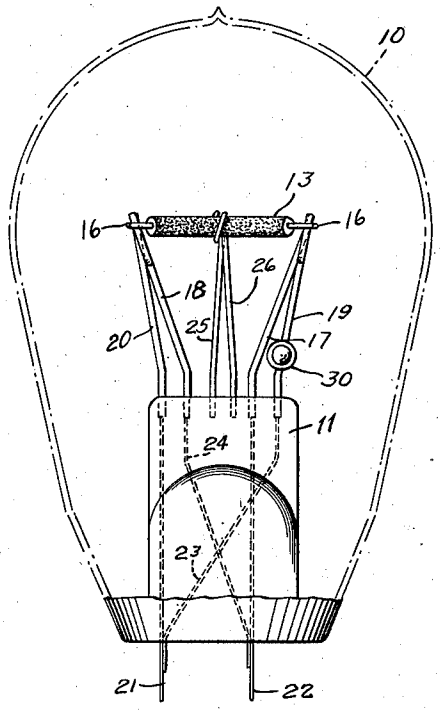


Fig. 3

Fig. 2.



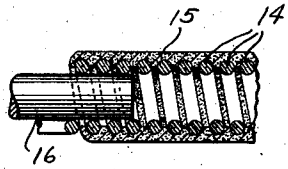


Fig. 4

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UNIFORM DISCHARGE LAMP

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Application November 17, 1930, Serial No. 496,142

5 Claims. (Cl. 176—123)

This invention relates to electric lamps and more particularly to that type of lamp which is shown and described in the application of Chester H. Braselton entitled "Electrical discharge device", Serial No. 459,048, filed June 3, 1930.

One of the objects of the invention is to provide an increased discharge area in a gaseous discharge lamp.

Another object of the invention is to provide a lamp in which a discharge takes place between two elongated elements each of which is capable of maintaining its own independent discharge.

Another object of the invention is to provide an electric lamp in which a discharge takes place between two elements, the potential between opposite points on the elements always having substantially the same relation to the breakdown potential of the gas between said points.

Another object of the invention is to provide an electric discharge lamp in which a pair of elements are spaced apart and a gaseous discharge is made to follow along each of the elements and to jump across the gap between them.

Other objects of the invention and objects relating to the method of constructing and assembling the various parts will be apparent as the description of the invention proceeds.

One embodiment of the invention has been illustrated in the accompanying drawing in which:

Fig. 1 is a plan view of the elements of my improved lamp;

Fig. 2 is a sectional side elevation of the lamp; and

Fig. 3 is a front elevational view of the press and elements of the lamp.

Referring now more specifically to the drawing, the lamp may comprise an envelope 10 of glass or other transparent material formed integral with a press 11 for sealing in the leading-in wires supporting the various parts of the lamp. A pair of elements 12 and 13 may be mounted spaced from each other and in substantially the same plane but each being curved with the convex side of the curve adjacent the other. Each of the elements may comprise a coil 14 of resistance wire, such as tungsten, molybdenum, tantalum, and nichrome, or other resistance material which is closely wound in a concentrated coil and the outer surface of the coil is coated with an electron emitting material 15. The electron emitting material may be any of the well known oxides such as those of the alkaline earth metals including barium, strontium and calcium which have an emissivity in excess of that of thorium oxide or mixtures of any of these oxides and should perhaps contain some material, such as calcium oxide, capable of selective radiation when heated.

At each end of the coil I may provide a rod 16, of tungsten or other metal capable of standing high temperature, which extends into the coil for a distance of two or three turns and to which the wires of the coil may be welded or the end of the coil may extend outwardly to be welded to the support rod alongside of the rod 16. The electron emitting material is preferably extended over the ends of the coil so that it covers a portion of the rod 16. The rod 16 increases the conductivity of the ends of the element where the discharge may concentrate and prevents burning out.

The element 12 may have its ends welded to two support rods 17 and 18 which may extend downwardly and inwardly to be sealed in the press 11, one at each end thereof. In like manner the element 13 may have its ends welded to two support rods 19 and 20 which may also extend downwardly and inwardly and are sealed in the press 11 adjacent the rods 17 and 18 respectively. The wire 19 may have a leading-in wire 21 connected to it and similarly the wire 20 may have a leading-in wire 22 connected to it. A wire 23 may be provided connecting the support rod 18 with the wire 21 while a wire 24 may be provided connecting the support rod 17 with the wire 22. This construction places the two elements in parallel, the end of one being connected to the opposite end of the other so that current flows through the elements in opposite directions.

If desired the center portions of the two elements 12 and 13 may be supported by means of wires 25 and 26 which may be sealed in the press adjacent the center thereof and which may extend upwardly being bent around the elements to hold them in position.

An ionizable gas 27 is placed in the envelope 10 and the pressure is predetermined so as to maintain the ionic discharge to the region of the elements 12 and 13. For this purpose the pressure of about 200 mm. of mercury is sufficient. I prefer to use about 50 mm. of neon and 150 mm. of argon which produces a discharge giving an intense bluish-white light. The gases used should preferably be chemically pure or at least should not have an excess of one percent impurities.

It will be evident from an inspection of Fig. 1 that opposite points on the two filaments will have a difference in potential between them as the corresponding ends of the elements are connected to opposite sides of the circuit. However

if two opposite points 28 and 29 are chosen on the elements 12 and 13 respectively it will be evident that the potential difference between the two points is less than the potential difference between the ends of the elements where they join the support rods 17 and 19 due to the resistance of the elements between the points 28 and 29 and their ends. Therefore, inasmuch as it is desired to have the relation between the potential difference of any two points on the elements and the breakdown potential of the gas between those points equal for any points on the elements, it is necessary to position these points closer together than the ends of the elements. It is for this reason that the elements are provided in curved form although if desired they may be bent at an angle with the vertices placed at the center and the sides extending away from each other.

With the elements positioned as indicated in the drawing and the envelope sealed onto the press the envelope may be connected in the usual manner to an exhaust pump and an oven may be placed over it to raise the temperature to somewhere in the neighborhood of 350 to 400° C. Current may also be run through the filaments to raise the temperature thereof to about 600° C. This heat is continued until a high vacuum of approximately .5 micron is obtained and all the gases have been removed from the envelope which is evidenced by no fluorescence when a high tension current from an induction coil is directed against the walls of the bulb. Current may then be increased through the filaments and the temperature thereof slowly raised until they are a bright red when the temperature will be about 800° C. This drives out any binder in the electron emitting material and also certain occluded gases which have not yet been removed. The pump continues to remove from the envelope any gases which are driven out of the elements or other parts.

When no more gas is found in the envelope the oven may be raised and the filaments heated to slightly less than 1200° C. to drive out any other occluded gases or vapors which may be present. The pump may then be shut off and a slight amount of an inert gas such as neon at a pressure of about ½ mm. may be admitted to the envelope and the filament current turned on again. This causes reddish spots of discharge to occur on the elements or other parts of the lamp which gradually increase in size until a diffused glow appears inside of the bulb substantially filling it and the action tends to activate the electron emitting coating to raise the electron emitting efficiency thereof. This process should take about ten minutes but if white spots appear it is an indication of other gases being present and the envelope should be exhausted again and the process repeated.

When the activation is completed the pump may again be connected to the envelope and the gas pumped out until the high vacuum is again produced. The filament circuit may then be disconnected and the pump turned off and about 50 mm. of neon gas admitted into the envelope followed by about 150 mm. of argon. The bulb may then be sealed off and is ready for use.

When the lamp is connected in a circuit current flows through the wire 21 where it splits going to the support rod 19 and end of the filament 13 and also to the support rod 18 and opposite end of the filament 12. Current passes through the elements 12 and 13 in the opposite direction and leaves the element 13 by means of the support rod 20 and the element 12 by means of the support rod 17 which are both connected to the wire 22. Owing to the pressure of the gas in the bulb the discharge from the elements 12 and 13 is confined to the region adjacent the element insofar as the outer space between the elements and the envelope is concerned or the other parts, including the support rods, and a brilliant bluish-white discharge appears surrounding the elements like a halo. However inasmuch as opposite points on the elements have a difference of potential and inasmuch as this difference of potential is greater than the breakdown potential of the gas between the points the discharge will jump from one filament to the other. Owing to the fact that the relation between the breakdown potential of the gas between any two points on the elements and the potential difference between those two points is always the same the discharge between any two points on the elements will be the same and hence a uniform discharge will take place between the elements themselves somewhat as indicated by the dotted line in Fig. 1 which will produce an intense bluish-white illumination. When the filament is heated the emission of electrons therefrom apparently ionizes the gas in the vicinity of the filament and electrons appear to leave the surface of the filament and travel towards a point on the filament having a higher potential. Thus the breakdown potential of the gas per unit length of the filament is less than the potential across such unit length necessary to cause a current to flow therein to raise the filament to operating electron emitting temperature. This must be true otherwise electrons would travel inside the filament. This relation between the breakdown potential of the gas and the current flowing in the filament is apparently only true in the vicinity of the filament, and if this were not so the discharge would probably fill the entire bulb instead of being restricted to the region of the filament.

If desired a metal vapor may be introduced into the bulb such as mercury, caesium, or rubidium vapor and various color effects may be obtained with the light by varying the gases and vapors used. Thus where a bluish-white light is desired as described above a predominance of argon may be used while if a red arc discharge is desired a predominance of neon may be used; where a green light is desired mercury vapor may be used.

The metal vapor may be introduced into the envelope by providing a salt of the desired metal such as mercuric, caesium, or rubidium chloride with magnesium in a small container 30 which may be secured to one of the support rods, such as 19, and may be provided with a pin hole out of which the metal vapor may pass when the container is subjected to sufficient heat, as by external bombardment after sealing off, the chloride dissociating into the chlorine and free metal. It may be desirable to use a small amount of caesium vapor with any of the above combinations as the caesium increases the conductivity of the gas and may produce a much more brilliant light.

While two elements have been shown and described it is evident that more than two might be used and so positioned that opposite points on any two of the elements will have a potential difference bearing the same relation to the breakdown potential of the gas between those points as the potential difference between any two

opposite points on any other elements bears to the breakdown potential between those points so that the discharge between the elements will always be uniform and of the same intensity.

Note should be taken of the construction of the ends of the elements as indicated in Fig. 4 where a support rod extends inside of the coil of the resistance wire. The discharge surrounding the element narrows down at the end of the element and might cause overheating at the end and burning out if this construction were not provided but where the rod 16 enters the coil the resistance point is low and overheating is avoided even though the discharge concentrates or narrows down at this point.

While the elements have been shown mounted in a horizontal plane perpendicular to the axis of the bulb it will be evident that they need not be mounted in the same plane at all and that they may be mounted vertically or in any other desired position as long as the proper spacing between the elements is maintained.

Many modifications of the invention may be resorted to without departing from the spirit thereof, and I do not therefore desire to limit the invention to what has been shown and described except as such limitations occur in the appended claims.

What I desire to claim is:

1. In an electric lamp a pair of conducting elements having an electron emissivity of the order of barium oxide connected in parallel with one end of one element connected to the opposite end of the other element, said elements lying in substantially the same plane with the centers thereof nearer together than the ends thereof, and an inert ionizable gas surrounding said elements, the breakdown potential of said gas per unit length of one of said elements being less than the potential across said unit length necessary to maintain said element to electron emitting temperature within the normal operating potentials of said lamp.

2. In an electric lamp a pair of filament wires, a coating of material having high electron emission capacity comparable to that of barium oxide on each of said wires, said wires being substantially in the same plane and having substantially the same resistance, and being positioned so that the centers thereof are nearer together than the ends thereof, means to connect one end of each wire to the opposite end of the other, and an ionizable gas surrounding said elements, the breakdown potential of said gas per unit length of filament being less than the potential along said unit length of the filament necessary to maintain said filament at electron emitting temperature within the normal operating potentials of said lamp.

3. In an electric lamp a pair of arcuate conducting elements having a high electron emission capacity connected in parallel with one end of one element connected to the opposite end of the other element said elements being substantially in the same plane the centers nearer together than the ends, and a mixture of argon and neon gas surrounding said elements.

4. An electric lamp comprising an envelope, a coil of resistance wire bent in the form of an arc within said envelope, a coating of conducting material having a high electron emission capacity on said coil, a second coil of resistance wire bent in the form of an arc and positioned with its convex side toward the convex side of the other coil, a coating of material having a high electron emission capacity on said second coil, said coils being connected together with one end of one coil connected to the opposite end of the other coil, and a mixture of argon and neon gas within said envelope and surrounding said coils and having a pressure of approximately 200 mm. of mercury.

5. In an electric lamp a pair of arcuate conducting elements having an emissivity in excess of that from thorium oxide connected in parallel with one end of one element connected to the opposite end of the other element, and a mixture of gases of the argon group surrounding said elements.

ROBERT HARDING, JR.